



# Containing a nuclear accident with ground-up materials



**COOLING DOWN** — Jessica Kruichak, left, and William Chavez tested granular calcite and sand against lead oxide. The granular calcite and lead oxide had a leavening and cooling reaction, whereas the sand did not produce a reaction. **Photo by Randy Montoya**

*Sandia's injectable minerals could stop contamination from spreading*

By **Kristen Meub**

**S**andia researchers are developing a promising new way to contain the hot molten mass that develops within a nuclear reactor during a catastrophic accident and prevent the spread of radioactive contamination.

During a three-year Laboratory Directed Research and Development project, a team of scientists discovered and patented a process for injecting sand-like minerals into the core of a nuclear reactor during an accident to contain and slow down the progression of a meltdown.

Sandia developed computer models and software (MELCOR) that model how corium, a highly radioactive lava-like mixture of nuclear fuel, fission products, control rods, structural materials and other components, melts

— CONTINUED ON PAGE 7

# 'Switching on' iron in clay minerals

*Researchers identify chemical mechanism that shows how iron in soils can immobilize arsenic*

By **Michael Padilla**

**S**andia researchers have discovered a mechanism to “switch on” iron residing in clay mineral structures, leading to an understanding of how to make iron reactive under oxygen-free conditions.

This research will help scientists understand and predict how contaminants such as arsenic, selenium and chromium move through the environment and enter waterways. These chemical principles can be applied to develop natural soil barriers to remove those contaminants from water and make reactive membranes, which can transform contaminants during the water filtration process.

The work is featured on the cover of a recent issue of *Environmental Science: Nano* in a paper titled, “‘Switching on’ iron in clay minerals,” by Sandia researchers Anastasia Ilgen, Kevin Leung and Rachel Washington, and Ravi Kukkadapu from Pacific Northwest National Laboratory. The work was funded by DOE’s Basic Energy Sciences program.

## Understanding iron reactions

“In geoscience, we recognized for decades that understanding how iron reacts is critical for understanding how contaminants move and



**UNDERSTANDING IRON** — Anastasia Ilgen run experiments in an anaerobic glovebox. **Photo by Randy Montoya**

transform in the environment,” lead author Anastasia said.

Iron is a key constituent of Earth’s crust and the fourth most common element, and iron-containing minerals make up a large portion of soils and sedimentary rocks, she said. Adsorption and chemical transformations on iron-containing mineral surfaces define the fate and transport of chemicals in the environment.

Anastasia said that iron in soils can exist in two oxidation states: reduced and oxidized. This is important because iron constantly cycles between these forms in response to slight changes in soil conditions.

“Clay minerals are exceedingly common in soils and they often contain iron in their structures,” she said. “The surfaces of clay minerals, which only contain oxidized iron, are not reactive. They adsorb arsenic, but don’t transform it chemically. However, these same surfaces become reactive as soon as a minor amount of reduced iron is introduced into the clay mineral’s structure.”

Until now, scientists have not understood how and why clay minerals with trace amounts of reduced iron react when no oxygen is present.

“We have discovered the mechanism by which oxidized iron in clay mineral structures reacts under oxygen-free conditions, and why trace amounts of reduced iron are necessary for the reactions to take place,” Anastasia said.

## Experimental tools, methods

Using experimental tools, the team pinpointed the exact chemical sites in clay minerals that react with arsenic. They showed that iron atoms located at the edges of clay minerals are reactive, and for the reactions to take place, these sites have to contain both reduced and oxidized iron.

The team used computational methods to calculate the energy required for oxidizing arsenic, which is adsorbed onto a site containing exclusively oxidized iron, in contrast to a site with both oxidized and reduced iron. These calculations showed that thermodynamically adding one reduced iron next to an oxidized iron does not make the oxidation of arsenic any more favorable.

To study the question of why the sites are reactive in the environment, the team used spectroscopic analysis to demonstrate that for a contaminant such as arsenic to oxidize on the surface of a clay mineral, it must displace water molecules from that

— CONTINUED ON PAGE 2

## 2,020 in 2020

### Annual Sandia Gives campaign kicks off in October

By **Amy Tapia**

Community Relations manager

The United Way's Sandia Gives campaign is very special to me, and I'd like for you to consider participating this year.

Sandia has a long tradition of giving generously to both the United Way and 501(c)(3) charities, beginning with its first United Way campaign in 1957. Sandia has since made it easier to support our communities by conveniently giving to the United Way of Central New Mexico through payroll deductions, while underscoring the critical role Sandians have in making life better for those in our communities who are struggling.

You may choose to allocate your donations to United Way or opt to give to other charities that support our communities. And the needs in our local communities are great. In New Mexico, 30% of children live in poverty. In the Bay Area, one in five residents lives in poverty. Too many young people in New Mexico and California are not completing post-secondary education and are unable to earn a living wage.

Local United Way organizations and many local nonprofits depend on Sandia employees' generosity to provide services to the most vulnerable among us. Every year, Sandians generously give through payroll deductions, providing more than 30% of the funds given to the UWCNM.

Sandia's workforce participation has been as high as 90% but is currently at an all-time low of 45%. This year, the Sandia Gives campaign is looking for 2,020 new Sandia Gives donors in calendar year 2020.

I remember being given a blue pledge card on the first day I started at Sandia. I signed

my name to receive my benefits and signed my name to commit 1% of my paycheck to the UWCNM. I was excited to work for a company that valued exceptional service to our nation, as well as to our local communities.

In the ensuing years, I served as a loaned executive to UWCNM and helped allocate donor funds to the programs that have the most impact in serving those in need. These experiences allowed me to better understand the tremendous needs in my community, and to see how the UWCNM and many nonprofits are working tirelessly to meet those needs.

United Way helps increase family stability and educational attainment. Children can't thrive and finish school when they're facing trauma, so the focus is on tackling the root cause of that trauma and preventing it for the next generation.

The United Way of the Bay Area also is addressing the greatest challenges faced by their residents who struggle to make ends meet with skyrocketing housing costs and a high cost of living.

National Technology and Engineering Solutions of Sandia and Sandia's senior leadership team have preserved Sandia's corporate giving, which represents another part of our giving culture. Annually, \$1.4 million of fees are invested in educational excellence, family stability and community leadership, primarily through grants to local nonprofits in Albuquerque, Carlsbad and Livermore.

NTESS is a UWCNM Corporate Cornerstone Partner, providing \$100,000 annually, as well as sponsoring UWCNM leadership giving groups, including Young Leaders Society, Women United, Hispano Philanthropic Society, Guys Give and the Tocqueville Society. These donor groups provide an opportunity for many of our dedicated Sandia employees who believe in the power of UWCNM to work together to make positive change in our community.

Maybe you aren't sure how much you can really afford. I get it — many new employees have graduated from college with debt, are purchasing their first homes or are starting families. Many midcareer employees might be preparing to send kids off to college.

You don't have to give a lot to make a difference. One dollar a week, or \$52 dollars a year, can provide 26 books for low-income children that have few or no books at home. Five dollars a week, or \$260 dollars a year, can provide 50 wool blankets for people living in a shelter. The idea is to participate, give what you can and be a part of



**HONORED MENTOR** — Community relations manager Amy Tapia was recently honored for her work as a mentor for Big Brothers Big Sisters of Central New Mexico during its 50th Anniversary Mentor Awards. **Photo by Roberta Rivera**

Sandia's commitment to doing what we can to improve the lives of our neighbors.

I look forward to increasing Sandia's participation in the Sandia Gives campaign, as you thoughtfully consider being part of 2,020 new donors in 2020. <#>

## Sandia Gives events

### Community Speaker Series

The Family Success Lab: The future of using data to inform social policy and outcomes for children and families, presented by Jennifer Ramo, NM Appleseed, Oct. 7, 12:30-1:30 p.m., Steve Schiff Auditorium

### Book Fair

Oct. 8-10 and 14-16, 10 a.m.-4 p.m., Steve Schiff Auditorium

Oct. 21-24, 10 a.m.-4 p.m., IPOC second floor breakroom (opens 11:30 a.m. Monday, Oct. 21)

### Giving Fair

See how your donation makes a difference, Oct. 15, 11 a.m.-1 p.m., Steve Schiff Auditorium courtyard

Managed by NTESS LLC for the National Nuclear Security Administration

## Sandia National Laboratories

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Livermore, California 94550-0969

Topopah, Nevada | Nevada National Security Site

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**EDITOR'S NOTE:** Lab News welcomes guest columnists who wish to tell their own "Sandia story" or offer their observations on life at the Labs or on science and technology in the news. If you have a column (500-800 words) or an idea to submit, contact Lab News editor Tim Deshler at [tadeshl@sandia.gov](mailto:tadeshl@sandia.gov).

## Iron in clay materials

CONTINUED FROM PAGE 1

clay mineral's surface. Detaching a water molecule is a necessary chemical step for attaching arsenic, to be able to oxidize it on the clay mineral surface, Anastasia said.

Calculations show that removing water from a site with both reduced and oxidized iron uses less energy than a site that contains only oxidized iron, she said. Because it uses less energy, it is easier to first attach and then oxidize arsenic on this type of chemical site on clay mineral surface, and that is why the reaction takes place.

Understanding this mechanism helps explain the fate and transport of redox-sensitive nutrients and contaminants in the environment, and why some of these persist in oxidized forms even in the absence of dissolved oxygen.

### Continuing research on iron in different natural minerals

Anastasia said the team will continue researching the chemical mechanisms that govern the reactivity of iron in different natural minerals, and will explore the conditions required for iron to be reactive in soils and sedimentary rocks.



**CHEMICAL DETECTIVES** — Former Sandia student intern Austen Tigges, left, and Anastasia Ilgen set up an experiment at the Advanced Photon Source at Argonne National Laboratory. **Photo courtesy of Anastasia Ilgen**

The team will use this knowledge to better understand the environmental fate and transport of contaminants and nutrients, and potentially design reactive barriers to prevent contaminants from entering waterways. <#>

# Q&A with Truman Fellows Thomas Hardin and Josh Rackers

By **Troy Rummler**

Since 2004, Harry S. Truman Fellows in National Security Science and Engineering have come to Sandia each year to pursue high-risk, high-reward ideas that support the Labs' national security mission.

This year, Sandia welcomes 2020 fellows Thomas Hardin and Josh Rackers, who began their three-year postdoctoral appointments this month.

"These two individuals stood out because we recognized a particular potential for them to make a positive impact on many mission areas," said Grant Heffelfinger, director of advanced science and technology program management, who approved the selections. "I'd like to thank the Truman selection committee for the time and energy they put into evaluating an exceptional pool of candidates."

Fellowships are extended to early-career researchers at the top of their respective fields. The selection committee, comprising senior scientists, evaluated each applicant.

The fellowship program also serves as an employment pipeline. Of 30 honorees, 18 joined the technical staff, and eight are still working at Sandia. Applications for fellowships starting next year will be accepted until Nov. 1, 2019.

Lab News spoke to the incoming fellows about their proposed research.

## Thomas Hardin: Keeping it glassy

Thomas is a materials scientist with expertise in the molecular dynamics of glass. He comes to Sandia from the Massachusetts Institute of Technology, where, in the process of completing his thesis, he discovered how little is understood about the structure and properties of glassy materials on the nanoscale. His three-year assignment begins with an endeavor to fill in those gaps.

He joins mentor Mike Chandross and manager Veena Tikare.

"I'm really looking forward to having Thomas be a part of our team," Mike said. "I think that he's going to make a lot of progress on this really difficult problem, and I can already see a number of other projects where his skills and knowledge will be extremely valuable."

Also, Thomas speaks Finnish, to which we say: Emme ymmärrä sinua!

### What's one thing people might not know about glass?

When I talk about glass, I'm referring to an entire class of materials stretching from the glass in your phone screen to fiber optic cables, vitrified nuclear waste and metallic glass materials with exceptional strength-to-weight ratios. It's so much bigger than window panes. And what all these materials have in common is their disordered atomic structure.



**GLASSY FELLOW** — Materials scientist Thomas Hardin joined Sandia as a Truman fellow in September.

Photo by Tyler Clites

### Why does their disordered structure matter?

In many metals and ceramics, the atoms are arranged in neat, orderly planes and rows. In glassy materials, however, the atoms are arranged in a disordered fashion. This disordered atomic structure can produce useful mechanical, optical and magnetic properties, among others, but also usually results in brittleness. Brittleness is one of the basic issues limiting the applications of glassy materials.

My proposed research is to systematically enumerate the fundamental structural building blocks of glassy materials. I want to look at small clusters of atoms in glass and figure out which atomic arrangements promote which properties. If we can figure out how to encourage formation of less-brittle configurations while retaining the useful properties that make glass attractive in the first place, that will be a huge win.

### What impact do you hope to make through your research?

My work will enable rational design of new glassy materials with reduced brittleness and enhanced useful properties like optical transparency, corrosion resistance or strength. This will expand the envelope of engineering applications where glassy materials are viable. I'm also hoping that my work will underpin improved joining and additive manufacturing techniques for glassy materials.

## Josh Rackers: Biologically inspired

Josh is a computational biophysicist. He credits his dad, an engineer, for getting him interested in science and for tricking him as a kid into thinking he could break the second law of thermodynamics. Now, Josh is designing new models for describing molecular dynamics in biological systems. Prior to joining Sandia, he earned a doctorate from Washington University in St. Louis.

"Josh will be a great colleague," said Susan Rempe, one of his Sandia mentors. "He shares my interest in high fidelity theoretical predictions and curiosity about biophysical mechanisms. I can't wait to work with him." Josh will also be mentored by Steve Plimpton, Aidan Thompson and manager David Littlewood.

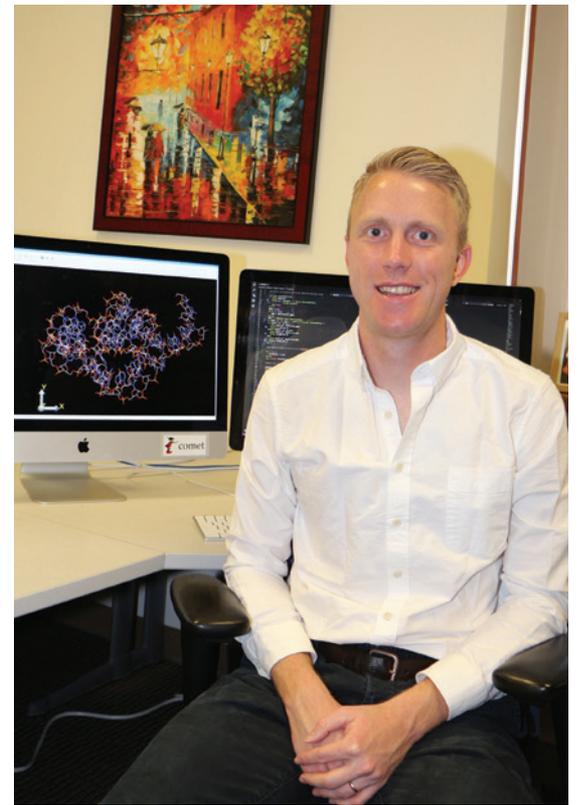
"Josh has insights into how to model important classes of soft materials at the atomic scale with high accuracy," Steve said. "We think his ideas will complement and extend the methods Sandia uses for modeling other kinds of materials."

### What's one thing you hope to accomplish as a Truman fellow?

The first thing I want to do is use computer simulations to understand how ion channels work. Ion channels are these molecules that sit in cell membranes, and they are ultra-important because they regulate how ions come in and out of cells. And by selecting which ions pass through, they're able to make sure that our heart beats and that neural signals are sent. It's also potentially important to things like water filtration and other industrial uses.

### How do ion channels fit into your long-term goals?

As a general matter, the big goal is to be able to take any molecule you're interested



**EYES ON IONS** — Biophysicist Josh Rackers joined Sandia as a Truman fellow in September. Photo by Gary Broyles

in, plug it into a computer and ask, "How does it move? How does it interact with something else?" And related to that, I'd like to develop tools that allow that to be done by anyone.

And then I guess the big, meta goal is to advance this perspective — even outside of science — that the behavior of our world, or at least the molecular world, can be completely understood from understanding how atoms bounce off each other — that everything comes from those atomic-level interactions.

### What are you looking forward to about Sandia?

There seems to be a real openness to trying research that is not guaranteed to work, but a good idea. And that's kind of a fun place to be. I'm really also looking forward to pushing the biomolecular research frontier at Sandia. Right now, it's a relatively small chunk of what Sandia does, and I'm looking forward to seeing if that can grow over time. 

SANDIA  
GIVES

# ANNUAL GIVING CAMPAIGN

October 7-25

Sandia's corporate giving campaign to support our local communities is a convenient and safe way to donate needed funds to nonprofit organizations through United Way.

Participate at  
[give.sandia.gov](https://give.sandia.gov)




# California site celebrates Family Day

By **Michael E. Langley**  
Photos by **Randy Wong**

**M**ore than 2,000 people spread out across Sandia’s California campus for Family Day on Sept. 14, getting a glimpse of the exceptional work done in the national interest by Sandia researchers and professionals from all over the world.

Deputy Labs Director Dori Ellis returned to Livermore to take part in the laboratory tours and demonstrations by researchers showcasing their work. Associate Labs Director for Integrated Security Solutions Andy McIlroy talked with groups of visitors about the breadth and depth of work at Sandia and even showed off some newly redecorated and refurbished areas unveiled especially for Family Day.

At the site’s general event pad, families were treated to food trucks, STEAM activities, a K9 demonstration by the Livermore Police Department, forensics demonstrations — including simulated human remains — by FBI agents and other activities for kids and adults.

Kayla Norris, who led the California event planning efforts, said, “For me, it was refreshing to see how proud our employees were to show their guests where they worked and how excited their guests were to receive the information, tours, STEAM demos for kids and nuclear deterrence seminars.”



Photo by Oscar Garcia



# Record-breaking crowds attend Sandia's New Mexico Family Day

By **Katrina Wagner and Randy Montoya**  
Photos by **Randy Montoya**

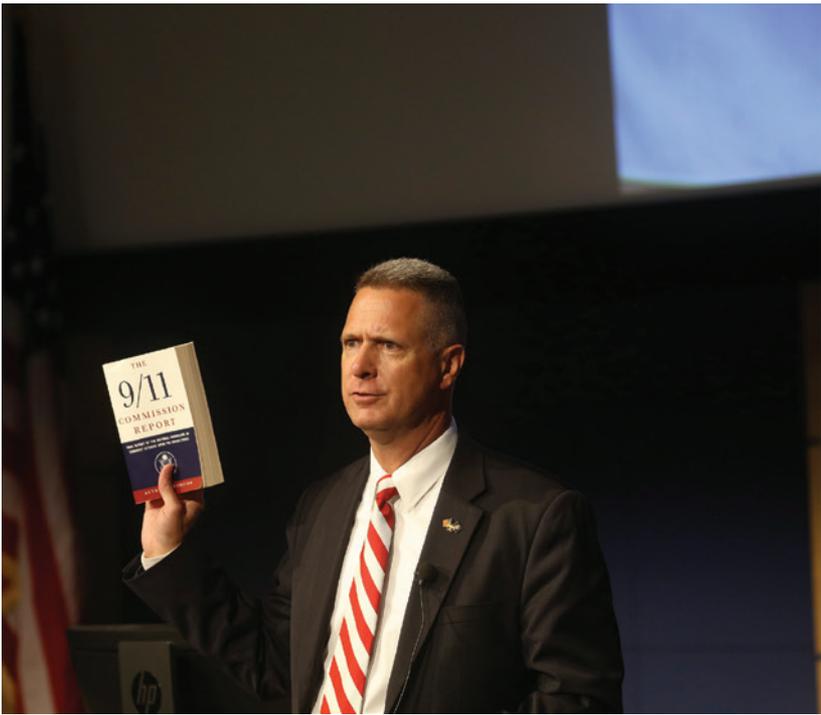
Family and friends walked the usually restricted streets of Sandia's Albuquerque campus during the Sept. 7 Family Day event, to show support for their loved ones and see where they work. The long tradition of Family Day is an opportunity to show friends and loved ones some of the interconnected teamwork and facilities that they don't usually get to see.

A large variety of activities were offered thanks to the enormous efforts of many Sandians, who worked hard to analyze, plan and execute both events. Some of the demonstrations, tours and exhibits included large particle accelerators, drop tests, hypersonic wind tunnels, the solar tower, photovoltaic fields, numerous science and technology demonstrations, fun kids' science experiments and more.

Katrina Wagner, lead planner for the New Mexico event, reported that attendance probably topped 17,000. "We were excited to host Family Day 2019 because we knew that at least 40% of our employees may have never been to a Family Day and would enjoy the opportunity to share their workplace with friends and family," she said.

The Family Day planning teams at both the New Mexico and California campuses began planning early last winter and consisted of representatives from Safety, Security, Facilities and Communications. Volunteers from across the Labs hosted more than 70 activities to give guests the opportunity to learn more about Sandia and its mission and programs, while promoting STEM education. [T](#)





# 9/11: A Day of Remembrance

**EVOLVING MISSION** — On the 18-year anniversary of 9/11, James Langenberg, current FBI special agent in charge for Albuquerque, presented “9/11 and the transformation of the FBI” in the Steve Schiff Auditorium. Langenberg was a supervisory special agent responsible for liaising with the House and Senate Intelligence Committees during the 9/11 attack, and for months following. His talk discussed the mission of the FBI, his personal experiences relating to the attack and how the FBI has changed to meet new world threats.

Photos by Lonnie Anderson



*[List of names of Sandia staff members who attended the event, including: James Langenberg, Steve Schiff, etc.]*

# Asian American conference selects Sandian 'most promising engineer'

By **Neal Singer**

**S**andia researcher Stanley Chou recently was selected one of three most promising engineers of the year at the 2019 Asian American Engineer of the Year conference in Dallas.

The AAEOY award, first introduced in 2002, honors outstanding Asian American professionals in science and engineering for their technical achievements, leadership and public service. Winners have ranged from Nobel laureates to astronauts and from academic institutions to corporate boardrooms.

The AAEOY said they gave the award to Stan because he is a leading innovator in materials synthesis and materials chemistry.

Stan is an expert in the field of graphene-like two-dimensional materials, and in the engineering of these materials for energy, catalysis and sensors. “Stan is at the forefront in their chemistry and engineering,” AAEOY said. “His papers and presentations have been cited over a thousand times.”

Stan is a committee member of the Materials Research Society. He was chair of the 31st Rio Grande Symposium on Advanced Materials and has served on the board of many educational organizations, including the Albuquerque Association for Gifted and Talents Students and the national mathematical education organization Campersand.



Stan Chou

Photo by Lonnie Anderson

# SANDIA CLASSIFIED ADS

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**AD SUBMISSION DEADLINE:** Friday noon before the week of publication unless changed by holiday.

Questions to Michelle Fleming at 505-844-4902.

Submit by one of the following methods:

- **EMAIL:** Michelle Fleming (classads@sandia.gov)
- **FAX:** 505-844-0645
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- **INTERNAL WEB:** Click on the News Tab at the top of the Techweb homepage. At the bottom of the NewsCenter page, click the "Submit a Classified Ad" button and complete the form.

Due to space constraints, ads will be printed on a first-come, first-served basis.

## MISCELLANEOUS

**DINING SET, 7-pc., marble top, dark cherry, easy maintenance, excellent condition, photos available, \$900 OBO. Sanchez, 505-228-4200.**

**FACTORY RIMS, for '17 GMC Canyon Denali, 4, w/o tires, w/factory lug & locking nuts, good condition, \$800 OBO. Keil, 417-770-0074, call or text.**

**MOVING SALE, Sept. 28-29, furniture, books, technology, bikes, 5625 Upland Meadows Rd., Rio Rancho. Hartenberger, 505-264-9583.**

**WOOD PELLET SMOKER, Pit Boss 440D, new-in-box, never assembled/used, \$350. Brewer, 505-293-7192.**

**SMARTPHONE, AT&T, G8 ThinQ, 128 GB, still in pkg., retail \$849.99, asking \$650. Choi, 505-554-4171, send text.**

**POPEJOY TICKETS:** “Jesus Christ Superstar,” Oct. 20, 6:30 p.m., 2, \$66 ea.; “Waitress,” Dec. 15, 6:30 p.m., 2, \$66 ea.; orchestra seats, east side, row P, inside aisle. Hoyal, 505-823-1421.

**TEAM/FAMILY YARD SALE, East Mountains, Sept. 28, 10 a.m.-2 p.m., San Antonio Elementary School parking lot (12555 North Hwy. 14). Portillos, 505-366-3582.**

**MIXED SEASON FIREWOOD, logged & split, truck load, \$125 or trailer load, 6' x 10', \$200. Vigil, 505-480-9749.**

**TRANSPORTATION**  
'15 CHEVY, original paint, great condition, price reduced, \$9,200 OBO; call for photos. Owens, 505-980-6796.

'14 ACURA ILX, 4-dr., 4-cyl., VTEC, 2.0L, white, heated seats, Bluetooth, moon roof, 73K miles, very good condition, \$12,800. Maldonado, pacomal@yahoo.com.

'11 BMW 135i, turbo, black int./ext., moon roof, navigation, clean, maintained, 70K miles, \$14,800. Wareing, 505-652-2883, call or text.

'11 TOYOTA CAMRY XLE, V6, leather, new tires & alternator, 97K miles, great condition, \$10,900. Hubbard, 505-379-4709.

'99 CROWN VICTORIA, silver, 1 owner, garaged, 126K miles, excellent condition, \$2,300. Ginn, 505-506-7680 or ol\_mp@yahoo.com.

## RECREATION

'19 RIVERSIDE RETRO TRAVEL TRAILER, w/ accessories, aqua/pewter, like brand new, never used, \$23,000. Ramos, 972-951-0290.

**MOUNTAIN BIKES:** Kona King Kikapu, excellent working condition, \$300; Raleigh M-80, excellent working condition, \$60. Wasiolek, 702-204-0529 or wasiolek@cox.net.

**MOUNTAIN BIKES,** East Mountains, men's & women's, like new, used only a few times, photos available, \$75 ea. Willmas, djwillmas@gmail.com.

'07 SUZUKI C50, sharp red & black paint, passenger backrest & bags, stock except windscreen, garage-kept. Backus, 505-504-6609, ok to text.

## WANTED

**COMPUTER PROFESSIONAL,** need help choosing new home computer & perform migration from old computer. Kaplan, 505-270-7425.

**BUTTERFLY CHAIR FRAME,** w/o w/o canvas sling. Woods, randjwoods@comcast.net.

**LEGO & ROBOTICS KITS DONATIONS,** for Kirtland Elementary School LEGO club. Adams, snadams89@gmail.com.

**VOLUNTEERS,** help rescued cats, Fabulous Felines charity, https://fabulousfelines.org. Stubblefield, 505-263-3468.

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3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. The same ad may not run more than twice.
7. No “for rent” ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce and retired Sandians only.
10. Housing listed for sale is available without regard to race, creed, color or national origin.
11. Work wanted ads are limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in poor taste.

# Mileposts



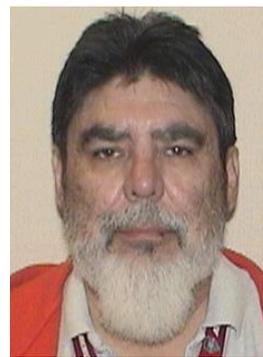
New Mexico photos by Michelle Fleming  
California photos by Randy Wong



Thomas Henderson 35



Sam Jones 35



Michael Martinez 35



Bill Miller 35



Tim Meisenheimer 30



Michael Ross 30



Ken Alvin 25



Kelly Gomez 25



Gabriel Gutierrez 25



Patti Sawyer 25



Tammie Towndrow 25



Martin Arrambide 20



Annie Garcia 20



Victor McLane 20



Karen Baca 15



Alla Fishman 15



Melissa Flury 15



Scott Frederick 15



Jennifer Gjullin 15



Ted Lapina 15



Rick Lujan 15



Robin Mitchell 15



Chris Olguin 15



Mark Smith 15



Melanie Tapia 15



Emily Weber 15



Debra Yzquierdo-Trujillo 15

**Correction**  
David Wheeler and Joe Saloio in Division 5000 have been promoted to Senior Scientists. They were incorrectly listed among the Distinguished promotions in the Sept. 13 issue of Lab News.

## Containing contamination

CONTINUED FROM PAGE 1

through a nuclear reactor and spreads during a meltdown.

“During a severe reactor accident, the vessel that contained the fuel melts and ruptures, and then all that stuff falls out on the containment floor and starts spreading,” nuclear engineer David Louie said.

Nuclear reactor accidents are rare, but when they happen, the consequences can be devastating to people, the environment and public trust in the safety of nuclear energy, David said.

As a national lab, Sandia researches all aspects of nuclear energy, from production to waste transportation and storage, and works to ensure safety is built into each step. This includes using computer software like MELCOR to model catastrophic accidents to understand why they happen and study how different scenarios change the outcome.

When corium spreads, it can escalate the release of radioactive material into the environment in two ways, David said. It can melt through the building floor and seep into the soil, and it can chemically react with the materials it touches. For example, when corium reacts with concrete, it can create

hydrogen gas, which can lead to a possible explosion.

In actual nuclear reactor meltdown accidents and in modeled scenarios, the traditional approach has been to use water to try to cool down corium, but this process hasn’t worked fast enough to prevent the accident from progressing and contamination from spreading.

“Eventually corium stops spreading because water will cool it down,” David said. “But you don’t want the accident to get worse and worse while you’re working to bring water in. The water also provides a source of explosive hydrogen.”

David, Yifeng Wang, Jessica Krulichak and other team members studied and tested natural carbonate minerals such as calcite and dolomite to determine whether they could help contain corium and keep a reactor accident from escalating. The first step was a small benchtop experiment using grams of molten lead oxide powder to simulate corium. The researchers heated the lead oxide to 1,000 degrees Celsius and then poured the molten material over granular calcite. As a control, they repeated the test with sand (granular silicon dioxide) instead of calcite.

“We saw that the injectable carbonate minerals work,” David said. “It reacted chemically to produce a lot of carbon dioxide, which ‘leavened’

the lead oxide into a nice cake-like structure. The reaction itself had a cooling effect, and all the pores in the ‘cake’ allow for further cooling.”

When sand was used in the control test, nothing happened, as the researchers expected.

The team then moved on to a larger kilo-gram-scale experiment using more lead oxide and granular calcite. They also repeated the sand control experiment on the larger scale. The results continued to show that injectable granular carbonates could be a promising solution to prevent corium spread, David said.

During the final year of the project, David, Yifeng, Alec Kucala, Rekha Rao and Kyle Ross translated the results of the experiments into MELCOR and built an accident sequence to model how injectable minerals would affect a nuclear reactor accident similar to the Fukushima Daiichi accident in Japan.

The team has a non-provisional patent in progress for the injectable materials and is hoping to perform larger experiments using depleted uranium in the future, David said.

“After that, we’d be ready to commercialize the technology,” he said. “These materials could be retrofitted into any existing nuclear reactor design.”

# 'Imagineering World Class Results'

How Disney uses creativity, imagination and engineering to orchestrate improvement

By **Meagan Brace**

Photos by **Brett Latter**

**W**ho do you think is world class? What do they do that makes them different and better?

These are questions Mark David Jones, a former Disney executive and current president of Small World Alliance, posed to more than 300 Sandians gathered in the Steve Schiff Auditorium on Sept. 4 for the Imagineering World Class Results presentation sponsored by Sandia's inclusion, diversity, EEO & AA organization. Jones shared behind-the-scenes insights on how Disney and other world class organizations consistently stay at the top of their game.

Behind the pixie dust and castles that come to mind when people think of Disney, Jones revealed that there's a massive operation of 72,000 full-time employees working backstage to create a magical experience for each guest.

"What Disney and other world class organizations have done is take a generally complicated business situation and they've made the effort to distill it down to its essence without oversimplifying it," Jones said. "If it's too complicated, it won't get implemented."

## Imagineering performance excellence

When tasked with improving Disney's operations, Jones turned to Imagineers, a group of people Walt Disney himself pulled together to combine creativity, imagination and engineering. Imagineers, he explained, take great ideas and bring them to life. They orchestrate any big improvement by working with everyone collectively to implement changes.

At the end of the day, Jones found that world class organizations need loyalty, advocacy and long-term success, which is determined by a "chain reaction of excellence" that begins with leadership.

"Here's the thing about world class organizations I find really interesting," he said. "They don't define leadership as merely someone with direct reports. They define a leader as anyone who has influence over the culture." Anyone can help create a culture of engagement with their colleagues in a way that focuses on exceeding customers' expectations, Jones said. The customers then become advocates for the company, which leads to growth and impact.

## Navigate with the Customer Compass

One tactic Jones shared to achieve success is the Customer Compass, a four-directional tool for understanding the people you work with by



**TOP IMAGINEER** — Mark David Jones addressed nearly 90 managers, describing how to create a chain reaction of excellence.



**MORE THAN PIXIE DUST** — Mark David Jones described the tools and tactics Disney uses to create a magical "on stage" experience for its guests.

guiding you to their expectations, style, walk and needs. Whether working with internal colleagues and managers or external stakeholders and sponsors, the tool can help all employees connect, engage and better understand those they work with, he said.

First, it is important to know what your customers' expectations are by having a discussion to understand what they really want. "You can't exceed expectations until you know what they are," he said. "Whatever you think your customers' expectations are, you are probably aiming too low."

Next, understand that people have different styles, similar to what the DiSC assessment characterizes as dominant, influential, steady or conscientious. These differences can make it more complicated and difficult to have effective working relationships, but "those differences are exactly what create the wow breakthroughs all the time," he said. Thinking from different perspectives leads many world-class organizations to consistent, higher performance and better teamwork.

Once you understand your customers' expectations and style, take a walk in their shoes, Jones said. Find out what they value and what their concerns are. "Instead of trying to be a hero to your customer, make your customer a hero to their customer."

Finally, assess their needs. Jones said that everyone has five needs that get to the heart of human decision-making and behavior: to be heard and understood, to belong and contribute, to feel stable and in control, to feel significant and special and to reach their potential. He encouraged the audience to look for opportunities to meet those needs by trying to understand their customer's perspective, finding common interests, providing options they can choose from, looking for opportunities to make them feel noticed and finding out what goals they aspire to achieve.

## Deliver your promise with pleasant surprises

For an organization to deliver on its mission, it needs to pay careful attention to the experience that its people, places and processes create.

To emphasize how important people interactions are, Jones shared a story of a Disney resort

housekeeper who carefully arranged children's stuffed animals as if they magically came to life and had been playing in the room while the family was exploring the parks. The kids were so excited when they returned to the room that the family, who frequently vacationed at Disney, wrote a letter to Disney thanking them for the experience. The frontline people, Jones said, are the ones who directly or indirectly influence the value of a customer's experience.

The environment also plays an important role, since attention paid to small details can make people wonder about attention paid to bigger, more important details, he said. At Disney, they use the phrase, "everything speaks" to describe how the five senses can pick up on how professional a place is, or the quality of service provided, right away.

Finally, efficient processes can make or break an experience, too. Instead of having executives come up with a solution to a problem, Jones emphasized the importance of involving the staff who are most familiar with the issue. "Let the people get involved who actually do the thing, and let's work together as a team to come up with something that works, that exceeds the expectations of the people that we're serving, and exceeds our internal expectations as a team," he said. "That's the whole key here: make it easy to do business with you."

## Be a leader, no matter your role

Whether you have a formal leadership title or not, Jones said the most successful leaders are the ones who emphasize influence over control. Be a trusted advisor by building relationships with trust and then use skills and abilities to credibly advise, he said.

Jones also said that world class organizations have a bias for action to gain buy-in, ownership and passion. "Let's start a conversation, but more importantly, involve as many different perspectives as is appropriate, and then do something, actually take that first step," he said. "To be extraordinary requires effort, and all of us individually have an influence on where this organization goes."

Jones gave his presentation to employees on Sept. 4 and to managers on Sept. 5. Sandians who missed the presentation can view the video on the IDEA SharePoint site. [f](#)